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NATURAL DISASTER REDUCTION: INTERRELATIONSHIPS BETWEEN
TECHNOLOGICAL AND NATURAL HAZARDS

Technical session

Natural and technological catastrophes and policy options:
a review of some experiences

Summary of presentation by Dr. Claudio Margottini, Ente per
le Nuove Tecnologie, l'Energia e l'Ambiente (ENEA) Italy

1. Many people have long understood, at least intuitively that continuing natural and technological (Na-Tech) catastrophes and the consequent environmental degradation will eventually exact a heavy economic toll and have a strong negative influence on the process of development. Unfortunately, no global economic models incorporate the depletion and destruction of the earth's natural support system. Only now we can begin to piece together information from several recent independent studies to get a sense of world-wide economic and social effects of Na-Tech hazards. In the meantime, there is a very complex interrelationship between natural and technological hazards, the comprehension of which is of basically importance to identify correct models of industrialization based on a global and safe environmental perspective.

2. Planning, mitigation and response are the main aspects to consider in a correct political perspective. Planning is looking forward (development), mitigation is looking backwards (to reduce effects on existing man-made structures and population), while response includes the capability of the social system to react to Na-Tech catastrophes (prevention, preparedness,

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post-disaster operations etc.). In planning aspects we have to consider that the expected output (hazard maps, microzoning maps, site selections) depend on the scale of the problem and on the scope:

(a) A regional scale requires hazard maps (e.g., the Italian project for the definition of areas that are identified as unsafe for energy power plants, in the light of different natural hazards and the technological consequences) that are mainly based on a long-term history of natural processes (i.e., the evolution of natural phenomena through geological, archaeological, historical and early instrumental investigations, during the quaternary - the past 2 million years - and particularly focused on the alocene - the past 10,000 years);

(b) A local scale requires the realization of microzoning map (e.g., the Italian experience after the 1980 Irpinia earthquake, or the studies of Rome) that are also based on a long-term history of natural processes, on geological, geomorphological, geophysical and other investigations and on an analysis based on past or recent post-disaster field surveys to check the expected theoretical results;

(c) Site selection requires specific experimental investigations to understand the behaviour of soil under seismic load (e.g., the ENEA project in Gioia Tauro plain in southern Italy which is to define the vertical modification of seismic signal due to geological and geotechnical elements in vertical array) and, in general, to understand the capability of hosting high-risk plants (e.g., the investigations for siting of nuclear power plants). Particular attention must be paid also to the mitigation of major accidents (for instance, the "Seveso" directive which emanated from the European Union).

3. In the meantime, parallel to technical operations, it is important to carry out a socio-economic impact analysis of technological and natural hazards. This should take into account: a global perspective of natural and technological hazards; a dynamic perspective; the demographic explosion of developing countries and, over all, the urban explosion which is dramatically outpacing every master plan of development, even after a few years (half a billion people live in cities today, a figure which is expected to double in the next 20 years); the promotion of environmentally sustainable development; environmental protection policies which, in the short term, may lead to a slower growth of income per head and which would be necessary to ensure the long-term sustainability of income growth and improvements in the quality of life. Because employment is a key factor in environmental degradation processes, particularly in the least developed countries, the central role of employment creation in the environmental processes should be emphasized by introducing a new operational concept of sustainable development.

4. The implementation of the above-mentioned action requires an effective communications system addressed to public participation. Very important also is the interaction among public administration (central and local), industry and the scientific community (ENEA was able to realize this in specific projects throughout Italy).

5. The realization of the various output proposed (hazard maps, microzoning maps, site selection) cannot be performed in a crude analytical way; it requires a certain degree of professional judgement, another important component of the mechanism. In practice, we have to consider that there are still many uncertainties and we cannot overcome all doubts by using sophisticated computer equipment and software. Only a disciplined collection of data, interpretation and professional judgement can support high quality computer elaborations.

6. Finally, emphasis must be placed on the role of the international community (technical and political) in supporting countries afflicted by Na-Tech disasters and in transferring experience and methodologies in planning and mitigation. In this regard, United Nations coordination efforts will be essential.

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Technical session

Addendum

An integrated approach to natural and technological hazard reduction

Summary of presentation by Professor Julio Kuroiwa,
National University of Engineering, Peru

1. Field surveys of past earthquakes, floodings, tsunamis, landslides and other natural disasters have clearly shown that the degree of damage and its geographical distribution largely depend upon the site conditions: soil characteristics, geology and topography. Based on these facts, after the catastrophic Peru 1970 earthquake, which left 67,000 victims, microzonation methods and techniques were developed first during the 1970s, improved during the 1980s and updated in the early 1990s. Microzonation studies include all potential natural hazards menacing the area of interest. The area is then divided into sectors of different hazards. The safest sectors are designated for the most important urban components, such as high-density residential zones, and major civil construction projects. To the most hazardous sectors appropriate uses are given, such as open recreational areas. In this way, physical safety is dramatically increased and in most of the cases, construction costs are reduced since development is carried out in harmony with nature and the lessons learned from past disasters.

2. Microzonation was first applied to urban planning for disaster mitigation in the early 1980s and to regional planning in 1986. In 1987, it was applied to the Trifinio regional development planning in Central America. The implementation of Peru's National Programme for Disaster Prevention and Mitigation - PNPDPM - was started in 1989, with the Grau regional model case study. The idea is for the methods developed and the experience gained to be

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applied in Peru's other 11 regions, and the resulting set of regional methods and techniques will combine to form the PNPDPM. This is the country's main activity for the International Decade for Natural Disaster Reduction and the key tool being used in microzonation.

3. As a member of the United Nations disaster mitigation programme in Colombia (1988-1991) and in Peru (1992-1995), the author also addresses technological disasters. In Colombia, one of the eight subprogrammes deals with how to provide rapidly information on poisonous chemicals, and how to handle, transport and store hazardous materials. In one of the other subprogrammes, technological accidents were regarded as secondary effects of a destructive earthquake in Cali, home to two million people. Peru's civil defence programme also includes the organization of an automatic computerized system on technological disasters.

4. In the microzonation investigation of industrial cities and port areas, it is necessary to consider all of the natural hazards threatening the area, and to assess the possible effects of industrial accidents whether triggered by natural hazards or otherwise. By adding an industrial hazard microzonation map to the natural hazard microzonation map, we obtain a natural-technological microzonation map which may be used for disaster mitigation land-use planning in the same way as the present maps are being used. Another useful result of this approach is the drawing up of a combined natural-technological scenario, which is the basis for preparing emergency plans to protect the population.

5. Failure to do this may result in a very hazardous situation. In Callao, Peru's main sea port, large oil, gas and gasoline tanks were well separated from the residential areas some decades ago. Uncontrolled urban expansion has located a large number of dwellings only tens of metres away from those large tanks, in a tsunami inundation zone. Something similar is happening in Tumaco, Colombia, at present. These situations may lead to natural-technological catastrophes.

6. Callao's port and industrial areas for which microzonation investigation was performed a few years back, and which included the defining of the tsunami inundation boundaries and the socio-economic conditions of the 120,000 people living in the most threatened areas, may be a good place to apply the proposed natural-technological integrated method for disaster prevention and mitigation. The results of this model case-study may be very useful to developing countries located in disaster-prone areas, as a means of protecting not only their population but also the investment to be made in the industrial sector for their socio-economic development.

7. On the other hand, the rapid population growth, especially in Third World countries, and the voracious appetite for energy in the industrialized nations greatly increase the human impact on the environment. In addition, technological development creates vast quantities of environmentally harmful products and by-products. By now almost everyone agrees that environmental degradation intensifies disasters. For the effects of urban expansion and the location of important civil works, an investigation of the environmental impact therefore needs to be added to the natural and technological microzonation maps. This is not a new concept; it is one of the main recommendations of the Rio Summit.

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Technical session

Addendum

Future disaster trends and policy implications for developing countries

Summary of presentation by Professor Enrico Quarantelli, Disaster Research
Center, University of Delaware, United States of America

1. As the developing world continues to industrialize and urbanize, it is continually creating conditions for more and worse disasters in the future that will, among other things, contribute further to environmental degradation and hinder developmental programmes. The processes of industrialization and urbanization, however positive in effects along certain lines, will both increase the number of potential disaster agents and the vulnerabilities of communities and populations that will be at risk.
2. Reasons for an increase are:
 - (a) Accelerating expansion of accidents and mishaps in the chemical and nuclear areas;
 - (b) Technological advances which reduce some hazards but make some old threats more dangerous;
 - (c) New versions of old and past dangers, such as urban droughts;
 - (d) Emergence of innovative kinds of technologies, such as computers and biogenetics, which present distinctively new dangers;
 - (e) An increase in multiple (e.g., natural disasters creating technological ones) or synergistic type disasters, resulting in more severe environmental consequences.

3. An increase in vulnerabilities will occur because:

- (a) Both natural and technological disaster agents will simply have more built-up areas to impact;
- (b) More vulnerable kinds of population will be impacted than in the past;
- (c) Metropolitan areas will be increasingly impacted and along certain lines the social organizations and group configurations of urban areas are not particularly well suited for coping with disasters;
- (d) There will be disastrous effects on an increasing number of localities from sources that may be quite distant;
- (e) Certain future disasters may have catastrophic potential even though they may produce no casualties nor do much property damage.

4. Although there are a few countervailing trends, these two sets of conditions will insure both quantitatively more and qualitatively worse disasters in the coming decades. Among the major implications are a furtherance of environmental degradation, in some cases polluting some areas almost forever and creating problems for future generations. Projected future disasters will also slow down the implementation of developmental programmes and perhaps even the adoption of otherwise worthwhile technological innovations. Policies can, however, be established and steps can be taken to reduce and weaken some of the negative effects of probable catastrophic disasters of the future, including:

- (a) Noting and accepting the fact that all disasters are essentially social occasions that primarily have to be dealt with by social more than technological means;
- (b) Eliminating the distinction in planning between natural and technological disasters and moving to an all-hazard or generic approach;
- (c) Assigning disaster mitigation at least as much priority in planning and application as emergency preparedness, response and recovery;
- (d) Integrating disaster planning more closely into the developmental planning or social change processes of the social system involved;
- (e) Ascertaining in which ways disaster problems are similar to and different from other environmental problems, and concurrently addressing both where there are similarities.

5. If the right policies and measures are put in place, the future will not be the past revisited or simply only the present repeated.